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A Continuous-Flow Bioassay Conducted on the Pennwalt Chemical Corporation's
West Plant Discharge #820120 Waste Effluent, Riverview, Michigan
December 3-7, 1973

US EPA RECORDS CENTER REGION 5



406681

Michigan Water Resources Commission
Bureau of Water Management
Department of Natural Resources
Environmental Protection Branch
Water Quality Appraisal Section
May 1974

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SUMMARY

1. A 96-hour, on-site, continuous-flow bioassay was conducted on the Pennwalt Chemical Corporation's West Plant discharge #820120 effluent at Riverview, Michigan, December 3-7, 1973.
2. Fathead minnows, Pimephales promelas, subject to the Pennwalt Corporation's effluent for 96 hours experienced significant mortality in concentrations of 6 percent and greater.
3. The 96-hour TL-50 (the concentration where 50 percent of the organisms could survive) was found to be 10.5 percent effluent.
4. The calculated safe effluent concentration for the receiving water is 1.05 percent by volume after mixing.
5. Fish in all effluent concentrations tested experienced hemorrhaging, loss of equilibrium, and immobility.
6. During the survey period the pH of the waste effluent fluctuated between 3.2 and 11.6.
7. The following values represent the highest concentrations of selected constituents found in grab samples taken from outfall #820120 during the survey; BOD (35 mg/l), suspended solids (21 mg/l), suspended volatile solids (6.0 mg/l), soluble orthophosphate PO_4-P (0.11 mg/l), total phosphorus (0.25 mg/l), nitrate nitrogen (0.37 mg/l), ammonia nitrogen (2.2 mg/l), organic nitrogen (9.0 mg/l), hexane extractables (13.0 mg/l), phenol (16 mg/l), and chlorides (140 mg/l).
8. The acute toxicity exhibited by the Pennwalt Corporation effluent is probably due in part to the combination of extreme pH fluctuation, high concentrations of ammonia nitrogen, and phenol.
9. The waste effluent discharged from Pennwalt's outfall #820120 could have an adverse effect upon the aquatic ecosystem of Monguagon Creek. The presence of high phenol concentrations may also lead to fish taint problems in the connecting waters.

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members. Samples were also collected and transported to the Water Resources Commission Chemical Laboratory in Lansing for analysis of BOD, suspended solids, suspended volatile solids, soluble orthophosphates, total phosphorus, $\text{NO}_3\text{-N}$, $\text{NH}_3\text{-N}$, organic N, hexane extractables, phenol, and chlorides.

Bioassay Results

Fathead minnows subjected to Pennwalt Corporation's effluent for 96 hours experienced significant mortality in concentrations of 6 percent and greater (Table 1). The 96-hour TL-50 was 10.5 percent effluent. The TL-50 is an estimate of the mid-point of the critical concentration range (the interval between the highest concentration at which all test animals survive and the lowest at which they all die). It is thus not usable directly as a dilution factor. From the TL-50 value, we must extrapolate to a "safe concentration" in the receiving water. Extrapolation is accomplished by means of an "application factor". This is a multiplier used to reduce the TLM value to a magnitude estimated to be relatively harmless to aquatic life in the receiving water. In dealing with the 96-hour TL-50 an application factor or safety factor of 1/10 is most commonly used to find the maximum safe concentration of effluent in the receiving waters when a specific application factor is not available for a particular waste. The maximum safe concentration for Pennwalt's discharge would be 1.05 percent effluent by volume after mixing with the receiving water.

Table 1 Percent Survival of Fathead Minnows after exposure to Pennwalt Chemical Corporation effluent - December 3-7, 1973.

<u>Percent Effluent</u>	<u>Percent Survival/Exposure Period</u>			
	<u>24 hours</u>	<u>48 hours</u>	<u>72 hours</u>	<u>96 hours</u>
25	100	70	0	0
22	100	90	0	0
20	100	80	0	0
18	90	70	0	0
16	100	100	60	20
14	100	80	70	40
12	100	90	10	10
10	100	100	90	70
8	100	100	90	70
6	100	100	80	60
4	100	100	100	100
2	100	100	100	100
0 (control)	100	100	100	100

Water Chemistry Results

The pH of the effluent discharged from Pennwalt's outfall #820120 was monitored by a continuously recording pH meter during the entire survey period. The effluent was found to have a fluctuating pH which ranged between 3.2 and 11.6. The effluent temperature, dissolved oxygen content and conductivity ranges during this same period were 57-60°F, 8.2-9.6 mg/l, and 280-700 μmhos respectively.

Table 2 Quantitative analyses of the grab samples collected from the Pennwalt Chemicals Corporation West Plant discharge #820120 and Detroit River water used as diluent in the bioassay.

Date	Time	No. Lab.	*F Temp.	D.O.	pH	Chlorine	Conductivity	BOD	Susp. Solids	Susp. Vol. Solids	Sol. ortho PO ₄ -P	Total-P	NO ₃ -N	NH ₃ -N	Org. N	H.E.	Phenol	Chlorides
12-3	2:30p	1E	57	9.4	9.0	0.0	350											
	7:30p	2E	59	9.0	4.2	0.0	450											
	10:30p	3E	59	9.2	6.3	0.0	375											
12-4	7:45a	4E	60	9.0	5.6	0.0	375											
	9:00a	5E	60	9.6	6.3	0.0	375	35	21	6.0	0.11	0.19	0.30	0.93	5.8	4.5	16	64
	1:15p	6E	58	9.0	9.1	0.0	375											
	3:30p	7E	58	8.8	9.2	0.0	280											
	5:00p	8E	60	8.8	8.9	0.0	450											
	9:45p	9E	60	8.0	8.6	0.0	375											
12-5	8:30a	10E	59	9.0	6.7	0.0	375											
	2:30p	11E	58	8.2	6.1	0.0	525											
	4:30p	12E	58	8.0	5.9	0.0	450											
	8:30p	13E	58	8.6	11.6	0.0	700					0.2	0.35	2.0	4.7			
12-6	8:30a	14E	58	8.2	7.1	0.0	400											
	12:30p	15E	58	8.4	5.5	0.0	450											
	3:30p	16E	59	8.8	5.8	0.0	450											
	8:30p	17E	58	8.4	5.4	0.0	550											
12-7	9:30a	18E	57	8.2	8.1	0.0	550	21	17	5.0	0.07	0.25	0.37	2.2	9.0	13.0	0.72	140
12-3	2:30p	1R	45	11.0	8.1	0.55	250											
	7:30p	2R	46	10.8	7.5	0.50	250											
	10:30p	3R	46	11.0	7.8	0.40	260											
12-4	7:45a	4R	45	11.0	7.6	0.45	240											
	9:00a	5R	45	10.8	7.5	0.40	240	<2	16	6.0	0.11	0.23	0.36	0.42	0.32	2.8	<.01	19
	1:15p	6R	45	11.0	8.8	1.1	300											
	3:30p	7R	47	10.8	8.8	0.0	550											
	5:00p	8R	45	10.8	8.9	0.0	260											
	9:45p	9R	46	10.8	9.0	1.5	325											
12-5	8:30a	10R	46	10.4	7.6	0.2	240											
	2:30p	11R	45	10.2	7.4	0.4	240											
	4:30p	12R	46	10.8	7.4	0.2	240											
	8:30p	13R	46	10.6	7.4	0.4	240											
12-6	8:30a	14R	46	9.8	7.8	0.1	260											
	12:30p	15R	46	9.8	7.7	0.0	240											
	3:30p	16R	46	10.0	7.7	0.3	250											
	8:30p	17R	46	10.4	7.8	0.3	240											
12-7	9:30a	18R	44	10.0	7.9	0.2	260	5	8	--	0.06	0.07	0.47	0.43	0.38	12.0	<.01	110

Notes: All values in mg/l except conductivity (μmhos) and pH (standard units).
 E = Pennwalt discharge #820120 effluent
 R = Detroit River water

Figure 1

SERIAL DILUTER

DELIVERING EFFLUENT CONCENTRATIONS OF 8 TO 100%

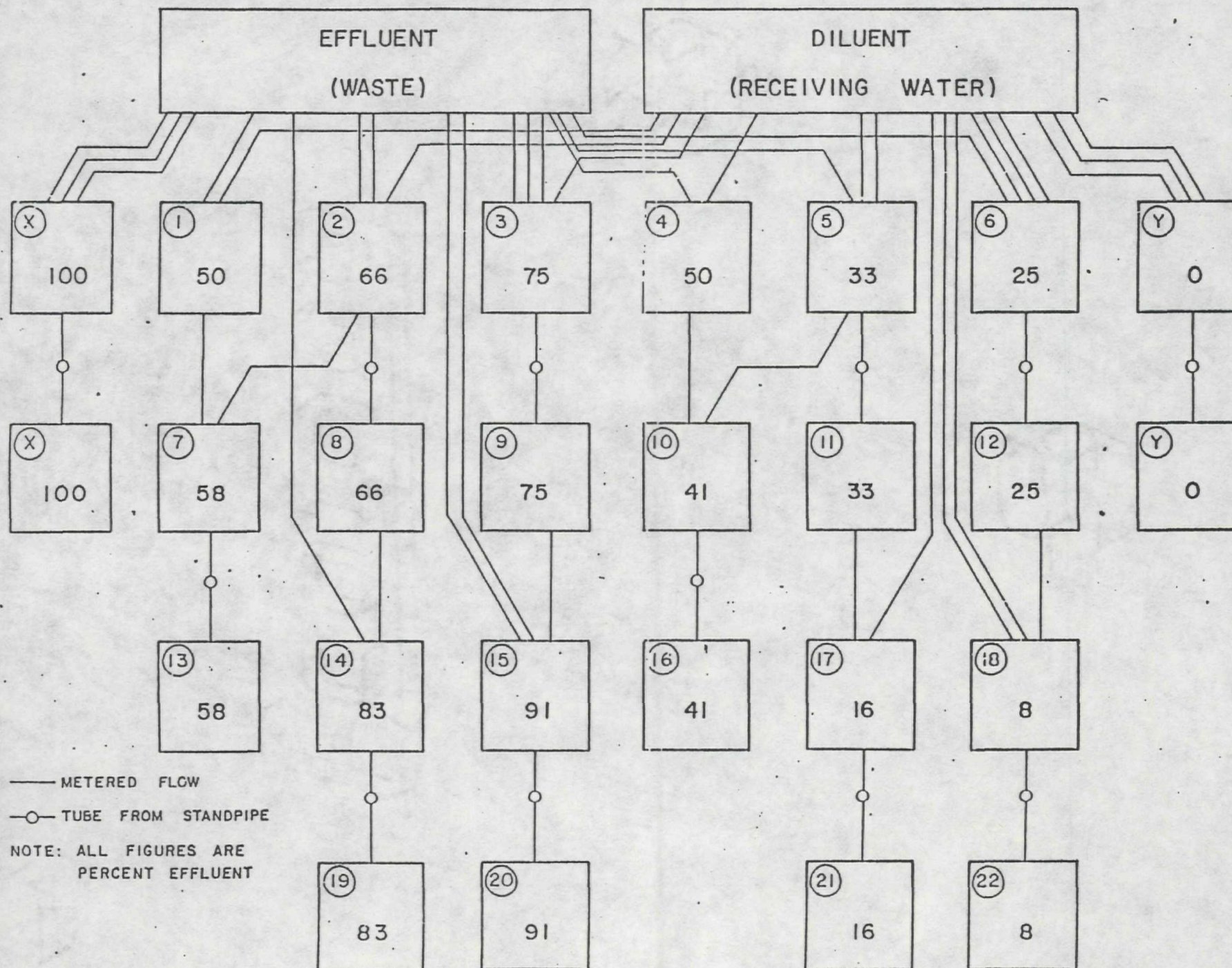


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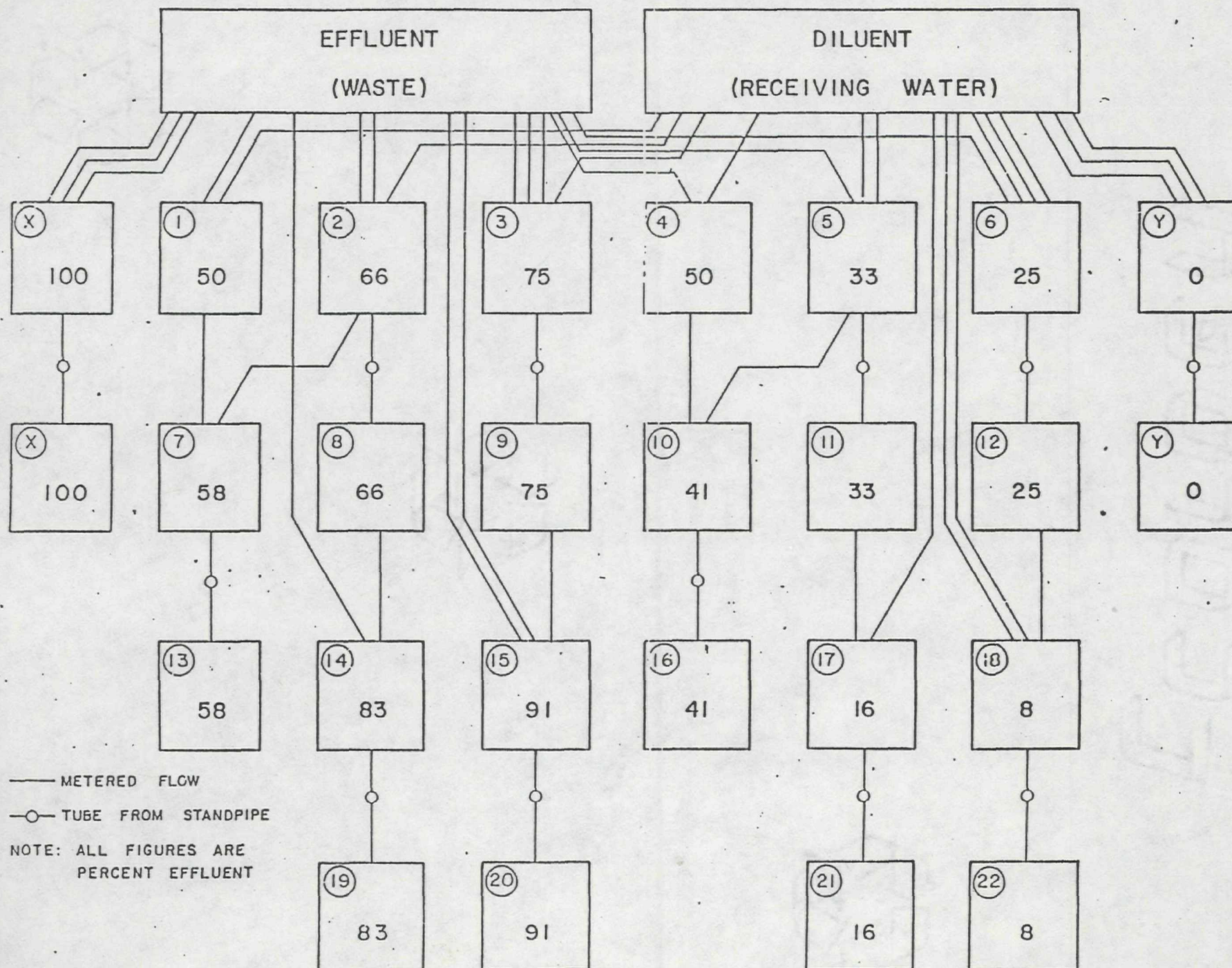


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8. The acute toxicity exhibited by the Pennwalt Corporation effluent is probably due in part to the combination of extreme pH fluctuation, high concentrations of ammonia nitrogen, and phenol.
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